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Three-Dimensional Simulations of National Ignition Facility Capsule Implosions*

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Hydrodynamic instabilities on ignition targets designed for the National Ignition Facility have been modeled previously using weakly nonlinear saturation analysis and two-dimensional single mode and multimode LASNEX simulations. We present here the first three-dimensional simulations of the NIF point design capsule, performed with the HYDRA radiation hydrodynamics code. These examine the growth of multimode perturbations seeded by roughness on both the inner and outer surfaces. The spectrum of modes, simulated over a portion of the capsule, extends up to values equivalent to spherical harmonic mode number l= 120. Simulations show that perturbation growth progresses well into the nonlinear regime, underscoring the importance of an accurate treatment of saturation effects. The greatest threat presented by short wavelength modes is to the integrity of the capsule shell during the implosion phase. Intermediate wavelength perturbations also develop into spikes of cold fuel which could quench the hot spot. We compare simulations performed using a variety of surface perturbations having different spectrum shapes and amplitudes. Results indicate that spikes can penetrate up to 10 μm into the 30 μm radius hot spot before ignition is quenched. Yields of up to 12 MJ have been obtained in simulations with realistic surface roughnesses. Perturbation growth will be compared with predictions of the weakly nonlinear saturation model. We will examine how convergence influences nonlinear evolution.

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